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INAUGURAL ESSAY

DANIEL A. ROBINSON







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AN
INAUGURAL ESSAY,

ON THE
TREATMENT OF WOUNDS OF THE

Femoral Vein.

SUBMITTED TO THE EXAMINATION OF

SAMUEL BARD, M.D. L. L. D.

PRESIDENT, AND THE TRUSTEES AND PROFESSORS OF THE

COLLEGE OF PHYSICIANS AND SURGEONS OF THE UNIVERSITY OF THE STATE OF NEW-YORK:

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DOCTOR OF MEDICINE,

ON THE SIXTH DAY OF THE 4TH MONTH, 1819.

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AN

Inaugural Essay, &c.

IF we search the records of most systematic writers on surgery, it will be found that very little is said of wounds of the veins : however, it is not our object to inquire into the cause of this omission. But, to show that the subject is worthy of particular examination, we quote the following : *First*, from Boyer, who observes, that “ the hemorrhage from a large vein may become very dangerous when the vein is the only one belonging to the limb ; for then the compression or ligature necessary to staunch the blood, hinders its return to the heart, and the member swells so prodigiously that gangrene may supervene. For example, if the femoral vein were opened at the groin, above its juncture with the saphena vein, there would result, from the compression necessary to stop the bleeding, a great tumefaction and its necessary consequences.”*

Secondly. S. Cooper, in his Surgical Dictionary, a work so justly and so highly esteemed, is silent on this point. We find in it, however, a reference to Dr. Hunter’s second operation for popliteal aneurism, wherein he included in one ligature the femoral vein with the artery. His patient died.

Thirdly. In Cooper’s and Travers’s Surgical Essays, a work lately published, may be found several interesting cases perfectly in point, from which it is thought proper to select the following : 1st, John White, aged 28 years, was admitted into Guy’s Hospital Nov. 22, 1816, for an aneurismal tumor in his left ham. During the operation of tying the femoral artery in the thigh with two ligatures, on Friday, Nov. 29, 1816,

* Vol. 1.—page 124. Alexander H. Stevens’ Translation.

a hemorrhage took place from a small wound of the femoral vein. The bleeding was at first troublesome, but was presently commanded by a ligature which was applied around the opening by nipping up its coats. Inflammation ensued in the vein, and the man died Dec. 31, 1816. “*Examination.*—The limb, and especially the leg and foot were œdematous; the surface of the wound was in a sloughing state, but it was filled at the bottom by granulations; the extremity of the divided artery presented a healthy appearance; the femoral and profunda veins were filled by adhesive matter. When a blow pipe was introduced into the upper extremity of the femoral vein, the air passed by it to the wound externally. The same was attempted to be done with the femoral artery, but it did not appear to have any communication with the external wound. The vein was next laid open: its internal tunic was covered with adhesive matter, and the sides at the lower part were adhering. It contained nothing like recent blood. All the coats were much thickened, and its capacity was gradually diminished downwards to the wound, where it was completely closed. There was an opening in the coats of the vein about three-quarters of an inch above the obliterated part, and this opening communicated with the external wound. Below the obliteration the wound was in a healthy state, the coats of the vessel were natural, and it contained a clot of blood. The adhesive inflammation had extended from the internal surface of the femoral vein to the iliac, as high as the bifurcation of the cava. The cava was also inflamed, but here the inflammation had not produced lymph or pus. The internal surface of the iliac vein presented the same appearance as the femoral; the corresponding iliac on the opposite side was not affected. The artery was next examined: its internal surface was healthy; the lymph plug extended some considerable distance above the situation of the ligature, and its extremity was contracted and closed. There was considerable serous effusion in the chest; one of the lobes of the left lung was covered with a recent

deposit of lymph, and the parenchymatous substance of the lungs appeared to have been inflamed. There was also a slight inflammatory blush on the surface of the intestines; the other viscera of the abdomen appeared in a healthy state."

Case 2nd. "John Crute, aged 30, suffered amputation of his right leg above the knee, for a scrophulous disease of that joint of long continuance. His health was in a considerable degree affected. During the first two days succeeding the operation, he appeared unusually low, often sighed deeply, and spoke but little. On the evening of the third day it became evident that he labored under more constitutional irritation than is common after amputation, and he was attacked at night with severe bilious vomiting, his bowels being freely open. Early on the following morning, (fourth day) the dresser was called to him, and finding that he had passed a very restless night, and had a hard quick pulse, he drew 20 ounces of blood from his arm, and administered some aperient medicine. His pulse lowered and became softer, and he expressed himself relieved by the bleeding; but the vomiting continued at intervals. At noon the stump was opened: the lips of the wound, which were generally adhering, were separated, and a copious discharge of grumous blood, accompanied with purulent sanies, followed. A fomentation and poultice were applied to the stump: in the evening an exacerbation of the symptoms took place; slight rigors were followed by fever and delirium. On the morning of the 5th day his pulse was thready and very rapid; his countenance sunken, and he had incessant low muttering: he continued sinking until 3 P. M. on the following day, when he died. *Examination twenty hours after death.*—The femoral artery in a healthy state; a firm plug of lymph obstructing the canal, which was contracted, as is usual where a ligature has been applied. On the mouth of the femoral vein was a ligature which the dresser, in the absence of the surgeon, had applied, for the purpose of restraining a hemorrhage, after the ligature of the artery, apparently proceeding from the vein:

he had done this without hesitaton, having frequently seen it done with safety by the surgeon under whom he had formerly studied. From the site of the ligature, along the femoral and external iliac veins, to the point at which the emulgents enter the latter vessel, the interior tunic was literally coated by large flakes of coagulable lymph. There were marks of diffused inflammation terminated as described. The vein in the right arm from which Crute had been bled by a free opening, was examined. The integuments had closed over the wound and the vessel was uninflamed. Between the mouths of the femoral vein and artery was discovered a small branch, arising immediately above the ligature of the artery ; and this vessel was doubtless that from which the bleeding had proceeded."

We wish to avoid as much as possible any unnecessary multiplication of facts ; but the following case is replete with pathological instruction, and for that reason we presume it will not be thought superfluous.

Case 3d. " A robust soldier, 36 years of age, was bled in the arm for opthalmal, which was considerably relieved by the operation ; a degree of fever, however, came on, and gradually increased. On the seventeenth day after the bleeding, his pulse was one hundred and twenty in a minute and feeble ; his skin was hot ; his tongue covered with a brown fur ; his respiration difficult : he complained of great prostration of strength, and pain in his head, back and extremities. The wound in the vein had healed, but the day after the bleeding great swelling and pain commenced in the arm, and gradually extended upwards. He was bled in the opposite arm, and various medicines were administered. The symptoms continued, with very little alteration, until the twenty-third day, when a painful swelling was observed above the clavicle ; and in a few days afterwards, another soft diffused swelling was discovered underneath the angle of the lower jaw. The symptoms increased slowly ; respiration became more painful and difficult ;

the pulse was seldom less than one hundred and twenty; he became delirious, and died in the course of the seventh week after the bleeding.

The following appearances were observed upon dissection:—the cephalic vein at the part where it had been punctured in the first instance, resembled an artery in the thickness of its coats, and retained its circular form when cut across; below the punctured part it was healthy; about an inch above the puncture its cavity was obliterated, the obliteration extended to the shoulder; the branches which communicated with the cephalic vein, at the bend of the arm, were healthy; the absorbent glands about the clavicle were enlarged and hardened; the internal jugular vein was much enlarged, thickened and indurated; the effects of inflammation were apparent throughout its whole course; it had the external appearances of an artery, though larger than any artery except the aorta; the subclavian, axillary and brachial veins, to the bend of the arm, exhibited similar appearances. The external jugular and subclavian veins were filled with pus: when slit open they were found to be much thickened and lined with lymph. Many of the smaller veins were in a similar condition. There was so much inflammation, adhesion and induration in the upper part of the arm that it was extremely difficult to trace the vessels, and detach them from their connections; the vena cava superior was healthy; the diseased appearances were not gradually lost, but terminated abruptly; the heart was healthy; the lungs contained some small abscesses. A serous fluid, with flakes of lymph floating in it, was contained in the cavities of the thorax; the lungs adhered to the pleura costalis, partially on the left side, but more extensively on the right; the structure of the brain was natural, but more serum than is usual was found in the ventricles; the veins of the pia mater were turgid with blood; the vena magna galeni, and sinuses were remarkably loaded.

Many cases might be adduced to show that ligatures, ap-

plied to large veins, are not unfrequently productive of serious, if not fatal consequences; but in a wound of a vein of the magnitude of the femoral, something must be done, and that too with promptitude; otherwise the patient will soon be exhausted by hemorrhage. As has already been observed, repeated trials have proved the ligature an improper application: compression, therefore, has been adopted, and under certain circumstances it has been attended with success. Dr. Rodgers, No. 14 Cortland-street, informs me that he has seen the case of a boy, who, at play with a penknife in his hand, accidentally plunged it into the femoral vein high up in the thigh, and although the hemorrhage was very profuse, yet, by the judicious application of compression, the bleeding was restrained and the boy recovered. Sometimes a ligature applied to the femoral vein is not attended with any bad symptoms. Dr. Hodgson has "known an instance in which it was included in a ligature without any unfavorable consequences;"* but cases of this kind are, however, very rare, so much so that the most scientific surgeons deprecate the application of them to veins upon any occasion, more especially to the femoral vein. I am very credibly informed that Astley Cooper, of London, has said that he would rather have his femoral artery wounded a dozen times, than to have his femoral vein injured once. When, therefore, a man so prominent in science and surgery as Astley Cooper is acknowledged to be, expresses himself in the above terms, it is time the subject had a most careful examination. But before entering particularly into an investigation of the treatment of these injuries, it is thought best to take a general view of the Anatomy, Physiology and Pathology of the vascular systems, referring more particularly to the parts about the thigh. This we think important, inasmuch as it will be explanatory of our views of the proper mode of treatment.

* An observation made in the dissecting-room by Dr. Sullivan, our Anatomical demonstrator, in the winter of 1817—18.

I. OF THE ARTERIES.

The arteries are composed of three coats: *First*, an external, membranous or muscular coat, which is very elastic: *Secondly*, a middle, muscular one, which is composed of two layers of muscular fibres. Those of the external layer extend longitudinally, and are comparatively few. The fibres of the internal layer are stronger and more numerous, and are arranged in segments of circles around the artery; but when collectively considered, they form a complete circle. The third or inner coat is composed of a transparent membrane, and is remarkably thin, smooth, and dense.

II. OF THE VEINS.

The veins, like the arteries, are composed of three coats, and are arranged in the same manner; but are remarkably thin and compact. The existence of a middle muscular coat has been denied by some anatomists, except in the larger trunks, as the two *venæ cavæ*. The veins are furnished with valves, which are very numerous in the extremities, and are generally described as being formed by a duplicature of the internal membrane. They are so arranged as to allow the blood to pass on towards the heart, but prevent its reflux.

III. COMPARATIVE VIEW OF BOTH SETS OF VESSELS.

The arteries, in consequence of the strength and thickness of their coats, are opaque, and retain their cylindrical form when cut across. The veins, on the contrary, collapse, and in consequence of their tenuity, are transparent. The coats of an artery are distinct, and can easily be separated: those of a vein are blended together, so much so as to be separated with the greatest difficulty. The veins, in consequence of their tenuity, are very extensible, especially in the transverse direction. The arteries have not this property. The veins, as has been shown, are furnished with valves. The arteries have no valves, except at the heart.

OF THE FEMORAL ARTERY.

The femoral artery, from the point where it emerges from

Poupart's ligament, to the going off of the profunda, will be designated in this dissertation as the *inguinal artery* : also the femoral vein, from the same point to the entrance of the saphena major, will be known as the *inguinal vein*. This arrangement will enable us to treat the subject with more perspicuity.

The external side of the inguinal artery lies immediately under the centre of a line drawn from the anterior superior spinous process of the os ilium, to the tuberos angle of the os pubis. So, if it becomes necessary to cut down upon this artery, our direction is : *First*, find the centre of a line drawn between the two points of bone above noticed ; then, laying the outside of the finger upon the point thus obtained, directly under the finger will be the artery ;* taking care to use the fore finger of the right hand when examining the right thigh, and vice versa. The inguinal artery is from an inch to an inch and a half in length : it lies upon the lower portion of the psoas magnus and iliacus internus muscles, and is covered only by the common integuments, some of the inguinal glands and fascia of the thigh. There are several small branches of arteries which proceed from it to the parts immediately in its vicinity, and to the external parts of generation. The artery, at its lower portion, gets deeper in the thigh, and opposite to the trochanter minor divides into the profunda and femoral, properly so called. The arteria profunda goes to the muscles of the thigh, and its branches inosculate very freely

* The outside of the fore finger is described by some anatomists to be that side which is next to the middle finger ; but we think it more natural, if not more correct, to call that the outside which is, in reality, on the outside ; and the inside of the finger to be on that side which is nearest to a line drawn between the middle and ring fingers. This may be considered to be a matter of little consequence ; but when made use of in describing the local situation of the inguinal artery, it becomes a subject of serious importance. Our learned and very able professor of anatomy, Dr. Post, in his lectures, described the outside of the fore finger to be that side which was next to the middle finger. It is hoped the importance of the subject may atone for a further apology.

with the branches of the internal iliac, and also with the femoral and popliteal artery, about the knee. In consequence of its numerous and free anastomoses, it is considered the most important artery of the thigh.

The femoral artery, where it leaves the inguinal artery, lies pretty deeply in the thigh; but in its descent it soon becomes more superficial and runs along the inner edge of the sartorius muscle for a short distance: it then takes somewhat of a spiral direction, inclining more inwards and backwards, and at the upper part of the lower third of the thigh it passes through the triceps muscle, lying close to the bone on its posterior surface. Continuing in this direction it passes between the condyles of the os femoris, where it receives the name of popliteal artery.

The inguinal vein lays on the inner side of the artery, and close to it. The vein is about the same length of the artery, and from an inch to an inch and a half below Poupart's ligament it receives: *First*, the saphena major: *Secondly*, from a quarter to half an inch below this point, the profunda vein enters. The inguinal vein then receives the name of femoral vein, which descends in company with the femoral artery, but in its course it inclines gradually to the posterior part of the artery, and after passing through the triceps muscle, between the condyles of the os femoris and behind the joint of the knee, it lays quite posterior to it.

The saphena, where it enters the inguinal vein, is consequently pretty deeply seated, but it soon becomes quite superficial and passes down on the inner and anterior part of the thigh; on the inner side of the knee joint and os tibia; fore part of the inner ancle, and so on to the foot.

We think this description is sufficient to point out the localities of the artery and vein under consideration, which it has been our object more particularly to do.

PHYSIOLOGY OF THE ARTERIES AND VEINS.

I. OF ARTERIAL CIRCULATION.

It is taken for granted that the blood, abstractly considered, possesses no power of its own by which it is enabled to propel itself forward: that, in this respect, it is like any other fluid, and subjected to the same laws of gravity and pressure. By this, however, we do not pretend to deny that it possesses vitality; on the contrary, it is admitted. The various changes which are effected in the pabulum of animal existence from the time the food is comminuted in the mouth, until it becomes a constituent part of the general system, passes through successive degrees of animalization and consequently corresponding degrees of vitality. Therefore, if we were called upon to define the blood, we should call it that substance in a fluid state which, after having passed through several successive degrees of animalization and vitality, becomes fitted for the heart and arteries, and by its presence and its peculiar properties, stimulates them to action, and which the arteries convey to the different parts of the system for its nourishment and support.

The degree of agency which the arteries exert in propelling forward their contents, is what we are particularly desirous to examine and elucidate; for a knowledge of this will direct us to one of the most important indications in the treatment of wounds of the femoral vein.

The blood, after being thrown into the aorta, is prevented from returning to the heart by the semilunar valves, consequently, when compressed by the contraction of the arteries, it must necessarily flow in that direction in which it finds the least resistance: this of course will be towards their extremities. That the blood is urged forward by the contraction of the arteries alone, we are far from believing: the impetus given to it by the action of the heart, is very great. However, that the arteries themselves do possess very considerable agency in propelling forward their contents, is inculcated by

some of our most enlightened physiologists. The strength of their coats, their muscularity, and the fact which before was not adverted to, of their muscular fibres (comparatively considered) increasing in the extreme branches, favor the idea that the more distant the arteries are situated from the heart, the more the blood is dependant on them for its motion.

It may be observed that the gravity of the blood has a very considerable effect in facilitating, and consequently accelerating its circulation through the arteries of the lower extremities when the body is in an erect posture. However, of gravity and pressure we shall have somewhat to say when speaking of the treatment.

II. OF VENOUS CIRCULATION.

The veins, originating from the numerous and very extreme arteries, receive their blood and convey it back again to the heart. In this act the veins, of themselves, are passive, or if they exert any power, it is very inconsiderable in effect. The fluid which they contain is also passive, that is, abstractly considered, it is so. Neither is any action excited in them by the heart's contraction. The blood, however, is returned by them to the heart, and some power must operate to effect this. The veins, as has been shown, are furnished with valves. These are very numerous, and exist in the greatest number in the extremities. They allow the blood to pass towards the heart, but prevent its reflux. Therefore, bearing in mind their anatomical structure, we attempt a solution of their function, thus : as the veins originate from the termination of the extreme arteries, there is the strongest probability that the blood may be conveyed in them for some distance by the impetus which it has received from the arteries ; and as two veins generally accompany one artery, and at the same time lay in close contact with it, one on either side ; that in this situation the pulsation of the artery affecting the veins, will compress them, and then allow them to dilate. Therefore, in the diastole of the artery, the veins will be com-

pressed, and by being thus acted upon, the blood which they contain is set in motion, and as the valves prevent its reflux, it, of course, must flow on towards the heart; because, in that direction it meets with the least resistance. Then, in the systole of the artery the veins being uncompressed and comparatively empty, are allowed to fill again. Thus, by the alternate action and reaction of the arteries compressing and unloading the veins, the blood is urged forward in them towards the heart.

It may be conceived, and the idea advanced, that this theory is insufficient to elucidate venous circulation. But it should be recollected that the diastole of all the arteries, which are very numerous, occurs at one instant of time, and therefore the united area of distention which they make will be very considerable: this applied to the veins, will make compression on them in the same ratio; and on the other hand, the systole of all the arteries takes place at a corresponding period, thereby allowing the veins to fill again. In addition to the above, it may be mentioned, that the strong aponeurosis which covers all the muscles and main mass of blood vessels of the thigh and leg, is dense, non-elastic and unyielding; so, the diastole of the arteries meeting with this resistance from without, must consequently effect compression more immediately upon the softer parts within—the veins.

In this view of the manner in which venous circulation is effected, the limb or extremity has been supposed to lie in an easy, natural position, perfectly quiet and at rest. But, if the muscles are put in action, the compression which they will make upon the veins will be so considerable, that the blood will be propelled towards the heart with greater force; and, as muscular contraction is not incessant, but attended with periods of relaxation, time is thereby allowed for the veins to fill again: so, by muscular action venous circulation is accelerated.

The blood is moved in the veins in a slow and progres-

sive manner; and in the lower extremities in particular, it is urged forward against the power of its own gravity.

OF PATHOLOGY.

For observations on the pathology of the blood vessels, we are more indebted to Dr. Travers than any other writer; and, indeed, he is the only person who has paid any particular attention to it. Therefore, on the present occasion, we shall make liberal use of the materials with which his talents have furnished us.

Under the head of pathology will be included the natural process observed in the healing of wounds of veins; the effect which a ligature has upon arteries and veins, and their morbid peculiarities under high excitement; and also, the resources instituted by nature when the principal trunk of an artery or vein is obliterated.

I. OF THE HEALING OF WOUNDS OF VEINS.

“When a vein is wounded longitudinally or obliquely, there is no separation of the edges of the incision, so that only a little, if any blood, trickles from the aperture, unless pressure be made nearer to the heart, to obstruct the passage of the blood in the vessel. If, therefore, an animal be killed immediately after a wound of the vein from which no blood has been drawn, the lips of the wound will be found in contact; and if permitted to live for a short time, the cicatrix will form a line.

“If a vein is opened by a transverse section, it bleeds without the addition of pressure; and if the vein is half divided, the hemorrhage is, with much difficulty, suppressed—the blood escaping into the cellular sheath of the vein, and of the contiguous muscles in the direction of the current, and forming a distinct coagulum between the orifice and the external wound. The longitudinal or oblique wound, by which blood has issued in quantity, presents the same appearances: an oval, naked coagulum forms the plug of the orifice, and a flattened covered clot, which is an extravasation into the cellular

sheath, extends to some distance around it. At the end of twenty-four hours the lips of the wound are found separated, forming an oval proportioned to the length of the incision; the edges everted and adhering to those of the clot; the eversion seeming to be the effect of distention from the extravasation into the sheath: there is no blush upon the edges, nor any appearance of organizable or secreted lymph in the vein or the wound. At three days the same appearances are observed, but the internal margin of the wound is somewhat elevated and rounded, and a thin and narrow membranous expansion is perceived to be continuous with the everted edge of the internal tunic; the clot itself is more compact, and upon section presents concentric lamellæ, the interior being of a lighter color than the exterior layers.

“On the fifth day these appearances are more confirmed; the membranous appearance extends over the surface of the clot, if the wound is not exceeding a quarter of an inch in length; and in larger wounds the coagulum, which is reduced in size, has a membranous surface. On the eighth day the new membrane is complete; the interior margin of the wound is raised and tumid, and the coagulum of a common bleeding wound is nearly absorbed. From the twelfth to the sixteenth day, numerous vasa vasorum may be seen by the aid of a glass, passing from the internal tunic over the new-formed membrane, and anastomosing upon it. At the latter period the edges are less raised, so as to be more upon a level with the new membrane, and have a slight red blush. The coagulum is entirely absorbed. On the twentieth day it is only possible to distinguish the recent from former wounds by the tenuity, smoothness and transparency of the new membrane compared with the old, which is dense, tough and wrinkled.

“This description applies to wounds of the size usually made in bleeding: the process is, of course, longer in completion, though not otherwise different in those which are more extensive. The coagulum which forms the plug, is exactly

proportioned to the size of the wound. The site and extent of the wound are ever afterwards marked by the membrane which occupies it, which is thinner, more transparent, and more extensile than the proper parietes of the vein. It forms, when the vein is filled, a pouch or bag; and the jugular veins of horses present many of these contiguous to each other. Farriers avoid bleeding in these pouches, because they find it difficult to staunch the blood. I at first supposed that this was a condensed cellular membrane, formed by the sheath of the vein; but I am satisfied that it is continuous with the everted edges of the internal tunic, and organized by its vessels. If it were consistent with what we know of reproduction, I should be disposed to conclude, that the new membrane was formed out of the coagulum of the blood, although I found that the coagulum could, with care, be detached from the membrane, which was continuous with the everted edge of the internal tunic. The new membrane is, however, evidently denser than the valves, in structure, which are said to be prolongations or even duplicatures of the proper tunic.”*

II. THE EFFECT WHICH A LIGATURE HAS UPON ARTERIES AND VEINS; AND THEIR MORBID PECULIARITIES UNDER HIGH EXCITEMENT.

1st. When a ligature is drawn tightly around an artery, it causes a separation of its internal and middle coats. Inflammation at the place of stricture, and for a short distance around it, ensues; coagulating lymph is then thrown out and an union of the sides of the artery is soon effected. The part immediately around which the ligature is passed ulcerates, and in a short time a division of the artery takes place, and the ligature is then discharged. No extension or diffusion of the inflammation takes place; no constitutional affection is thereby induced; the injury is merely a local one, and productive of no evil effect.

* Cooper's and Travers' Surgical Essays, part first.

It then may be said of arteries, they inflame readily, heal quickly, and no constitutional affection is thereby induced.

2d. When a ligature is put around a vein and drawn tightly, it does not cause a division of its internal and middle coats, but the vein falls in longitudinal folds. That part next the heart collapses, the other end is distended with blood, which soon coagulates. There is no redness or other signs of inflammation on the internal tunic; consequently, no adhesion takes place, and no agglutination of the contiguous folds, but the cellular sheath is thickened by a deposit of lymph in the vicinity of the ligature, which, after a little time becomes so considerable as to encompass the ligature: ulceration ensues, and about the fifteenth or twentieth day the ligature is cast off: no thickening of the proper coats ensues, nor appearances of inflammatory action within the canal, neither of the upper nor lower portion of the vein. But when inflammation of the vein does ensue, it extends along the vein towards the heart, sometimes from the point of irritation as far as the right auricle. Lymph is effused, which coats the inner tunic of "the vein like a fringe; and though the quantity effused is sometimes sufficient to obstruct the tube, the inflammation is not bounded by the obstruction." Pus is sometimes effused, "and the inflammation is often mixed, presenting both terminations alternately, viz. in lymph and pus."*

Although the inflammation generally extends from the point of irritation towards the heart, or from branch to trunk, yet, "in some instances the inflammation has extended downwards as well as upwards in the course of the vein. The same symptoms have taken place when the inflammation has been excited by the application of a ligature."†

In a summary view of the pathology of the veins, it may be said they are not very susceptible of inflammation, and

* Cooper's and Travers' Surgical Essays, page 242, vol. 1.

† Hodgson, on Diseases of Arteries and Veins, page 515.

when it does ensue, it spreads very extensively, producing great constitutional irritation with all its dreadful consequences.

It therefore becomes very important to know when inflammation of the vein does ensue while compressed by a ligature. We may reply, "the fatal catalogue of tied veins" has induced surgeons to proscribe its application to them. We are aware that there are many cases on record wherein no unfavorable symptoms have followed the application of a ligature; but it may be observed, that these successful cases are more particularly confined to the ligation of veins about the neck, thereby assisting to confirm the fact, that wounds of the upper part of the body heal quicker, and with less injury to the constitution, than those of the same extent and nature of the inferior extremities.

III. OF COLLATERAL CIRCULATION.

1st. Of arterial collateral circulation.—It is a fact well established in surgery, that the circulation will be carried on in a limb sufficient for its support, even though its principal artery be obliterated. This fact has been repeatedly proven by the many successful operations on the external iliac artery, (and there might be added the subclavian artery, and even the *arteria innominata**) and accordingly, at the present day this artery is ligated, without hesitation, as often as circumstances render it necessary.

2d. Of venous collateral circulation.—The principal vein of a limb is not obliterated with the same freedom or confidence of success. However, there are on record some very singular cases of obliterated veins, which are worthy of being noticed. Dr. Baile mentions an instance in which the *vena cava inferior*, of a female subject, was obliterated from the entrance of the emulgents to the right auricle of the heart. "In this remarkable case, the *vena cava inferior* was obliterated where the *venæ cavæ hepaticæ* open into it, so that not only

* The Medical and Surgical Register of Cases in the New-York Hospital, 1818.

the blood from the lower extremities, but also that from the liver must have passed through collateral channels to the heart.*

Dr. Hodgson "has seen two instances in which the common iliac vein was obliterated." In one of them, "the external and internal iliac veins on the left side were obliterated by the pressure of an aneurism of the abdominal aorta; the vena azygos was as large as the little finger, and extended on the left side into the loins, where it received two considerable branches which communicated with the lumbar veins, and with branches which came from the pelvis." "In both these cases there were no symptoms which indicated obstruction in the venous circulation during the life of the patients."

The two preceding cases have been selected more particularly on account of the fact which was contained in the last clause, viz. that "there were no symptoms which indicated obstruction in the venous circulation during the life of the patients." This is what could not, *a priori*, be looked for: however, it leads us more strongly to conclude, that the obliteration must have taken place in a very gradual manner, thus allowing the collateral veins to enlarge by slow degrees; for if even the external iliac vein was obliterated suddenly, and at the same time the principal artery of the thigh perform its function, there is the strongest probability that the tumefaction of the limb would be so great that gangrene, and ultimately death, would ensue.

Having thus completed our original design, of giving a view of the importance of the subject under consideration; and also, the anatomy, physiology and pathology of the blood-vessels, more particularly of the thigh, we are now prepared to enter into a particular investigation of the treatment, commencing—

Firstly. With wounds of the Inguinal vein.

Secondly. With those of the proper Femoral vein.

* Hodgson, on the Diseases of Arteries and Veins, page 526.

Wounds of either vein will be divided according to the nature of the injury: 1st. Incised wounds, or those caused by cutting instruments. 2d. Lacerated or contused, as those caused by musket balls, blunted instruments, &c. 3d. Ulcerated or sloughing wounds, as those produced by a corroding ulcer, or sloughing bubo or ulcer, &c.

Incised wounds will be subdivided into, *First*, Longitudinal. *Secondly*, Transverse.

OF LONGITUDINAL INCISED WOUNDS OF THE INGUINAL VEIN.

A surgeon, when called to a person bleeding profusely from a wound of the inguinal vein, (and the same applies to blood-vessels in general,) will have his attention directed immediately to the hemorrhage, and accordingly his indications, which are naturally suggested, are, 1st, to restrain the bleeding. 2d, To devise the best means for speedily healing the wound.

Means of accomplishing the first indication:—Compression in wounds of veins is generally resorted to, and in most cases it is the best means that can be adopted: accordingly, in longitudinal incised wounds of the inguinal vein, it would be entirely entrusted to; but an elevated position of the foot we think an important auxiliary, not only in this particular case, but in wounds of the blood-vessels of the thigh and leg generally. Therefore, our notions respecting this particular position will be given in full, before proceeding any further with a detail of treatment.

An elevated position of the foot is, we believe, not mentioned by any systematic writer on surgery, as being worthy of notice in the treatment of wounds of the blood-vessels. Therefore it is deemed expedient to be more particular in an investigation of the subject.

In our physiological remarks it was observed, that the blood, abstractly considered, possessed no power of its own by which it was enabled to propel itself forward; that, in this

respect, it was like any other fluid, and subject to the same laws of gravity and pressure.

Of fluids it is commonly said, 'they press equally on all sides at the same height.' But to make the subject, as we think, a little more explicit, we say that fluids, in consequence of their gravity, have a tendency to disperse and flow in that direction in which they find the least resistance, and the force of their dispersing power, or gravity, is in proportion to the height of their column. Therefore, when the body is in an erect posture, the arterial blood of the lower extremities flows with freedom and ease, because it is then assisted by its own gravity, which has the pressure of the column of blood from the top of the head to assist in urging through the branches of the lower extremities. It is presumed the truth of this assertion will not be questioned by any who know that fluids press equally on all sides at the same height, whether contained in a straight tube or one having as many branches and convolutions as the numerous arteries of our frame.

Now, if the posture of the body be changed, and the foot be elevated, (which, when a person is lying on his back, may be raised to an angle of 45° and even 55° without occasioning any pain from tension of the muscles on the posterior part of the thigh,) then the gravity of the blood will operate so as to retard arterial circulation in the limb; and if our patient be a person of ordinary height, or five feet and ten inches, his whole leg and foot will be two feet and eleven inches long; taking for granted the thigh, leg and foot to be half the length of the whole frame, which, as a general principle, is correct. —Then his foot raised to an angle of 45° will be two feet from an horizontal plane, or if at 55° it will be two feet and a half; therefore, the effect which an elevated position has, will be equal to the gravity of a column of blood two feet, or two feet and a half high, which, doubtless, from what has already been said, will now be perceived to have very considerable effect to retard the circulation. But the flow of arterial blood into

the limb when the foot is elevated, may be shown to be lessened on a different principle than that of gravity alone. Thus the blood, by its pressure and its peculiar properties, stimulates the heart and arteries to action, and the strength and force of their contraction is dependant very much upon the quantity of blood present in them. If, for instance, the quantity be very small, there is, of course, less stimulus applied, consequently, there will be less action produced: the alteration of the pulse, so universally effected from the common operation of blood-letting, is sufficient to illustrate this fact. Therefore, when the foot is elevated, and part of the blood abstracted from the limb by its gravity, this, operating as blood-letting, lessens the contractile power of the arteries, which disenables them to urge forward their remaining contents with the same degree of energy as formerly. Moreover, it must appear evident to all, that the great distance at which the extreme arteries of the foot and leg are situated from the heart, allows an elevated position of the foot to command a vast influence over arterial circulation, to retard it.

When, therefore, it is established that an elevated position of the foot does retard the flow of arterial blood into the limb, it is clear there cannot be so much to be returned by the veins; consequently, the hemorrhage cannot be so dangerous. But this is not the only advantage which position affords; for when the foot is elevated it favors, in the highest possible degree, the ready circulation of venous blood. The valves, in this position, are of no use; because the blood, as soon as it gets into the veins, flows towards the heart by the power of its own gravity. But if the limb be in a horizontal posture, or more particularly if the foot be a little depressed, the blood is urged on towards the heart by a *vis a tergo*; consequently, all the veins of the limb will be full, and even distended with blood. It is, therefore, evident, that under these circumstances hemorrhage will be more profuse, and far more difficult to restrain than when the foot is elevated. Besides, when the

column of venous blood is considerably lessened, and what remains is placed under the most favorable circumstances for its circulation, it is evident there cannot be any accumulation of blood in the veins to make lateral pressure; but on the contrary, the veins being half empty, and verging towards a collapsed state, not only will favor very much the coaptation of the sides of a longitudinal wound, but will, to a very great degree, lessen the hemorrhage. Therefore, in longitudinal incised wounds of the inguinal vein our practice would be, *First*, an elevated position of the foot. *Secondly*, lateral compresses to be placed on either side of the wound. *Thirdly*, a circular bandage applied so as to secure the compresses. This, we presume, is all that will be necessary. Care, however, should be taken not to draw the circular bandage too tight; for it cannot be necessary, and if pressure be made so as to retard the flow of blood through the vein, it certainly would do injury.

OF TRANSVERSE INCISED WOUNDS OF THE INGUINAL VEIN.

The degree of danger attending wounds of this description will depend upon the extent and depth of the incision; but all transverse wounds, more especially of the inguinal vein, are infinitely more dangerous than longitudinal ones: the reason of this is very obvious: the longitudinal contraction of the vein separates the edges of the wound, and thereby produces a circular hole in the vein, which will admit a more ready exit for the blood: this hole will be larger or smaller in proportion as the wound of the vein is more or less extensive.

If the incision be a small one, and the hemorrhage not very considerable, the treatment recommended in the preceding case will be applicable in this, viz. an elevated position of the foot, and compression.

In all transverse wounds there will be more or less retraction of the common integuments, as well as the coats of the vein. Consequently, this will afford a freer exit for the

blood. This circumstance might induce the surgeon to make use of a stitch to bring the sides of the wound in contact: if the needle be directed no deeper than merely through the skin, or only a little distance below it, it may then be admissible, and even proper; but beware of "nipping up the coats" of the vein for the purpose of applying a ligature around them:—this practice, experience has shown, is fraught with danger, and should be deprecated. There is the greatest probability that the closure of the wound externally by a stitch, with moderate and judicious compression, the hemorrhage will be restrained; observing, at the same time, an elevated position of the foot as important, in a high degree. But when the vein is nearly or quite divided, the danger from hemorrhage becomes exceedingly great: in short, it is one of the most alarming and difficult cases surgeons have to contend with. If we are fortunately called in at the moment, and compression be promptly applied, the bleeding may be restrained; but if it be continued long "the member swells so prodigiously that gangrene may supervene." Therefore, on an occasion like the present, we stand in need of all the information which the science of surgery can afford.

When recounting the condition of our patient and laying our plans for his cure, it is not sufficient, it is not right to look no further than the bleeding orifice, and there confine all our endeavors for his relief. It is well known that the veins receive their blood from the extreme branches of arteries, and consequently, when a vein is divided, it bleeds from the lower portion of the orifice; however, it may be supposed to proceed also from the superior portion of the vein; but for the most part it will be found that the perfection of the valves is a security against any danger from this source. Though we have not been able to examine a variety of subjects, yet, having an opportunity a few days ago in our dissecting room of closely inspecting one, it was found in this subject that the valves were perfect immediately under Poupart's ligament: so,

even though the inguinal vein should be completely divided, there would be no reflux of blood from the external iliac. Whether a valve is invariably found at the above place, we are unable to say; but, as the epigastric vein and circumflex vein of the os ilium enter the external iliac almost directly under Poupart's ligament; are pretty large in size, and from the fact that valves are most generally found where large veins are entering, it may be fairly conjectured that, as a general rule, there is a valve situated under Poupart's ligament. If this be the case, the retrograde course of the blood will be stopped, and hemorrhage proceed from the lower portion of the divided vein only.

Now, if there be a valve in the upper portion of the vein, the blood above it, taking a retrograde course, is stopped by the valve, which will thereby not only keep the vein distended, but, by its pressure upon the valve, will render it in some degree tense; and the venous blood from below, meeting with this resistance, and at the same time finding an open passage externally, will, of course, all pass in that direction. Now, to restrain the bleeding, it will be necessary to completely obliterate the calibre of the vein by compression. To effect this, very considerable force must be used, and all the small anastomosing veins on the posterior part of the thigh be compressed: the direful consequences of which have already been explained. All this we think may be avoided by tying up the inguinal artery; for then the blood will be prevented from flowing through it, and all its numerous branches will immediately cease to pulsate; consequently, the veins are not only debarred their source of blood, but even the quantity which they already contain is prevented from circulating by the removal of the *vis a tergo* given to them by the pulsative motion of the arteries. Therefore, very slight compression will be required to restrain the blood.

It may be asked, why not direct an elevated position of the foot in this case, as well as any other? We reply: the re-

traction of the ends of the divided vein will be so considerable, and the external opening so free, that it will be necessary to completely obliterate the calibre of the vein before the hemorrhage can be restrained. Consequently, when the vein fills with blood (as it will do if the artery be not tied or otherwise compressed) there will be a column of blood as high as the elevation of the foot to be supported by the compresses and bandages. This, therefore, would not only be very difficult to accomplish, but, even though it should be effected, the compression which would thereby unavoidably be made upon the numerous, though small anastomosing branches of veins on the posterior part of the thigh would, as we have already observed, completely obstruct all circulation through them. But where is the objection to tying up the inguinal artery? Surely, the numerous and generally successful cases of tied arteries, is sufficient to do away all objection; and when we recount the advantages thus obtained, they will be found by no means inconsiderable. Our patient can then have his wound dressed easily. If necessary, a stitch or two may be used to bring the retracted integuments in close coaptation. Lint, compresses, and short adhesive straps will be sufficient to restrain the bleeding: then, by laying him in bed on his well side, his lame leg may be placed in an easy, natural position, and supported by pillows, cushions, &c. thus allowing the numerous, though small anastomosing arteries and veins of the internal iliac and profunda, the most perfect liberty to enlarge and support the limb by a free circulation of blood.

OF LACERATED OR CONTUSED WOUNDS OF THE INGUINAL VEIN.

Wounds of this description are more difficult to heal, more insidious, and consequently more dangerous than incised ones of the same extent. The contusion so diminishes and sometimes even destroys the vitality of the part, that extensive sloughing is very liable to take place, and consequently,

secondary hemorrhage is to be looked for, and particularly to be dreaded.

Treatment.—A detail of treatment is deemed quite unnecessary. The principles promulgated in the preceding instances, are applicable in the present.

OF ULCERATED WOUNDS OF THE INGUINAL VEIN; OR,
WOUNDS CAUSED BY A SLOUGHING ULCER AT THE
GROIN.

These varieties have been named merely because we think the same principles of treatment applicable to them. The only difference would be in the local remedies, and the nature of the affection must dictate them; but as wounds of this description, and also those which are lacerated or confused, take a long time to heal, and are particularly dangerous on account of their liability to hemorrhage, it becomes more imperiously necessary to take up the inguinal artery.

OF WOUNDS OF THE PROPER FEMORAL VEIN.

We have nothing in particular to offer on this subject: however, it may, perhaps, be proper to observe, that in wounds of this vein, whether incised, lacerated or ulcerated, we think it never will be necessary to take up the inguinal artery, but that an elevated position of the foot, with compression applied directly over the wounded vein, is all that will be necessary.

It should be recollected that the saphena vein is sufficient to carry on the circulation even though the proper femoral vein be obliterated; therefore, in making compression on the proper femoral, pressure on the saphena should be avoided as much as possible. Our views of the proper method of applying compression are the following:—have three long and wide splints; arrange them longitudinally around the thigh so as to leave a space on the inner and anterior part of the thigh, or along the course of the saphena vein, about two inches wide. Apply a roller over the splints just firm enough to keep them steady. Then one inch distant from the wound, on the low-

er portion of the vein, or that portion next the foot, place the tourniquet. Have, then, some graduated compresses, formed in a conical shape; place the apex of the cone over the wounded vein—the other end of the compress, or its base, under the strap of the tourniquet, then turn the screw of the tourniquet, and compression will be made more directly upon the wounded vein.

It is thought best to apply the compression a little below the orifice of the wound, for then the wound may be dressed without disturbing the splints, compresses, &c. and not only that, but it is presumed the wound would heal quicker. But compression applied in this manner never will be necessary except when the vein is divided, or nearly so.

When the wound of the vein is small, an elevated position of the foot will so much lessen the volume of blood in the vein and facilitate the circulation of that which remains, that the veins, in a great measure, will be kept empty; consequently, there will not be lateral pressure enough to force the blood out of the wound. Lint, lateral compresses, and adhesive straps to secure them, we presume, is all that will be necessary.

Of the period of time an elevated position of the foot should be persisted in:—Our knowledge of the healing process will be our guide in this respect. If, therefore, the wound be a longitudinal one, and small in extent, an elevated position may not be observed longer than forty-eight hours; for by that time we may fairly conclude the lips of the wound have united. When, however, the wound is more extensive, the process of healing will be slower; consequently, an elevated position of the foot must be continued longer: also, as venous hemorrhage is very liable to recur; all exertion should be proscribed until the wound be fairly healed.

It may be proper in this place to observe, that the lint which was applied immediately to the orifice of the wound, should not be removed until it is loosened by the process of ul-

ceration; for it is not improbable that within the space of twenty-four hours the circulation may be so far restored in the limb as to produce, if the lint and close dressings be forcibly detached, a dangerous hemorrhage; and not only that, a premature removal of the dressings and lint may disturb the healing process, and thereby cause the inflammation to rage violently, which, eventually, may be either very difficult to suppress, or fatal to the patient.

If the elevated position of the foot should, after a time, produce numbness and coldness of the leg and foot, reason would dictate to us the propriety, and even necessity of lowering the limb.

THE END.

ERRATA.

Page 4—10th line, for “adhesiev” read “*adhesive*.”

“ 6—20th line, for “ophthalmi” read “*ophthalmia*.”

“ 8—The *note* being misplaced, the reader is requested to omit it altogether.

“ 23—3d line, for “pressure” read “*presence*.”

Perlegi.

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